Tamarind seed processing and by-products

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Abstract: Tamarind is a very large tree with long, heavy drooping branches, and dense foliage. Completely grown-up trees might reach up to 80 feet in height. Tamarind (Tamarindus indica) is found in many countries in Asia, Africa and South America. Tamarind can tolerate five-six months of drought conditions; hence tamarind crop can grow in any type of climate. Tamarind pod contains 30% pulp, 40% seed and 30% shell by weight. Conventionally, tamarind pulp is used for preparing different food products and medicated products. Tamarind seed and shell occupies 70% of the pod weight. Tamarind pod shell can be used as fuel, absorbent for the removal of methylene blue and amaranth dyes from aqueous solutions. Tamarind seed can be used after processing, i.e. after removing outer layer of the seed in food industries, textile industries, craft industries, furniture industries. Some of the uses of tamarind by-products are discussed in this paper.

Keywords: tamarind, tamarind pod, tamarind pod shell, tamarind seed, tamarind gum, tamarind oil

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1 Introduction

Tamarind (Tamarindus indica) is an economically important tree, found in many countries in Asia, Africa and South America. The tree can grow to a maximum height of 25 m and a crown diameter of 12 m. It is ideal for drier-arid regions, especially in areas prone to prolonged drought. Tamarind can tolerate five-six months of drought conditions; hence tamarind crop can grow in any type of climate. Tamarind is a tree that is easy to cultivate and requires minimum care. It is generally free of serious pests and diseases, and has a life span of 80-200 years and can yield 150-500 kg of pods per healthy tree/year at 20 years of age. During each season, the tree bears curved fruit pods in abundance covering all over its branches. Each pod has hard outer shell encasing deep brown soft pulp enveloping around two-ten hard dark-brown seeds. Its pulp and seeds held together by extensive fiber network.

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India is the world's largest producer of tamarind and it is estimated that 300,000 t are produced annually. The tree mostly grows wild, although it is cultivated to a limited extent. It is particularly abundant in Indian states of Madhya Pradesh, Bihar, Andhra Pradesh, Karnataka, Taminadu and west Bengal. India is also an exporter of tamarind, mainly to Europe and Arab countries and lately to the United States where over 10,000 t are exported annually (El-Siddig, 2006). Thailand is the second largest producer with a record of 150,000 t for the year 1995 with the majority of tamarind being the sweet variety (El-Siddig, 2006). Mexico also produces tamarind commercially to a volume of approximately 29,600 tons per year, exporting small amounts to the US, Central and South America (Silva, 2006). Other minor exporters are found in Costa Rica and Puerto Rico and Africa produces tamarind widely in small quantities for domestic consumption.

Farmers used to harvest tamarind pods by climbing the trees. They will remove shell and by hitting with small wooden piece. This activity is very laborious and time consuming activity. All family members used to involve in this activity. After removing of shell and seed they will hit the pulp with wooden piece to make pulp tender. A machine was developed for removal of tamarind cover and seed from the pods. The capacity of the machine is 100 kg/h, efficiency of the machine is 90% (Anil et al. 2005). See Figure 1 please.

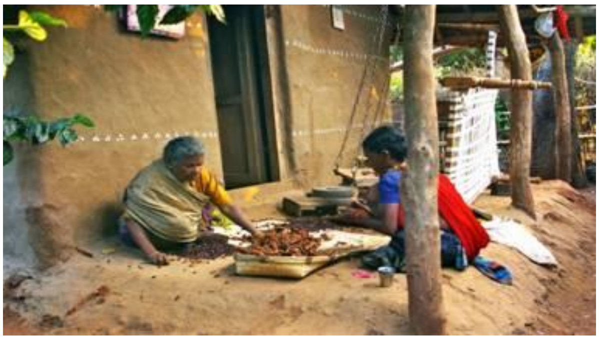

Figure 1 Tamarind covers and manual seed removal

Tamarind contains 30% pulp, 40% seed and 30% shell by weight. Conventionally farmers are selling pulp only, remaining seeds and shells simply they are not using.

In spite of having good nutritional values and easy availability, low cost, different studies were undertaken for effective utilization of tamarind by-products such as tamarind seed, shell etc. See Figure 2 please.

Figure 2 Tamarind pods

1.1 Why Tamarind?

- It is a versatile fruit whose value can be added into a number of different consumer products. The seeds, barks and stems have also been shown to have medicinal properties.
- The demand for tamarind processed products exceeds supply in Port Vila. Similar unfulfilled demand has also been recently reported in India who is one of the biggest producers and exporters of tamarind in the world (El-Siddig, 2006).
- Tamarind has been grown in the Pacific since the 1700s but the value-added commercial potential of tamarind has not been realized and there is a lack of awareness of the potential of tamarind at the village level.
- There is anecdotal evidence that the crop could be more profitable to farmers than Copra or Kava.
- A skilled private sector processor/retailer is interested in developing the industry and building farmer capabilities to increase volumes.

1.2 Health benefits of Tamarind

- Tamarind fruit contains certain health benefiting essential volatile chemical compounds, minerals, vitamins and dietary fiber;
- Its sticky pulp is a rich source of **non-starch polysaccharides** (NSP) or dietary-fiber such as gums, hemicelluloses, mucilage, pectin and tannins. 100 g of fruit pulp provides 5.1 or over 13% of dietary fiber. NSP or dietary fiber in the food increases its bulk and augments bowel movements thereby help prevent constipation. The fiber also binds to toxins in the food and thereby help protect the colon mucus membrane from cancer-causing chemicals.
- In addition, dietary fibers in the pulp bind to bile salts (produced from cholesterol) and decrease their re-absorption in the colon; thereby help in expulsion of “bad” or LDL cholesterol levels from the body.
- While lemon composes of citric acid, tamarind is rich in tartaric acid. Tartaric acid gives sour taste to food besides its inherent activity as a powerful antioxidant (Anti-oxidant E-number is E334). It, thus, helps human body protect from harmful free radicals.
- Tamarind fruit contains many volatile phytochemicals such as *limonene, geraniol, safrole, cinnamic acid, methyl salicylate, pyrazine* and *alkyl-thiazole*s. Together these compounds account for the medicinal properties of tamarind.
- This prized spice is a good source of minerals like copper, potassium, calcium, iron, selenium, zinc and

magnesium. Potassium is an important component of cell and body fluids that helps control heart rate and blood pressure. Iron is essential for red blood cell production and as a co-factor for cytochrome oxidases enzymes.

In addition, it is also rich in many vital vitamins, including thiamin (36% of daily required levels), vitamin-A, folic acid, riboflavin, niacin, and vitamin-C. Much of these vitamins plays antioxidant as well as co-factor functions for enzyme metabolism inside the body.

1.3 Medicinal uses of Tamarind

▪ Its pulp has been used in many traditional medicines as a laxative, digestive, and as a remedy for biliousness and bile disorders. This spice condiment is also used as emulsifying agent in syrups, decoctions, etc., in different pharmaceutical products.

2 Tamarind Pulp

The most valuable and commonly used part of the tamarind tree is the fruit. The pulp constitutes 30%-50% of the ripe fruit (Purseglove, 1987; Shankaracharya, 1998), the shell and fibre account for 11-30% and the seed about 25%-40% (Chapman, 1984; Shankaracharya, 1998). The large range is associated with heterozygosity since many cultivated forms have been seed propagated (Benero et al., 1974). The mean composition of tamarind is given in Table 1. The pulp contains oil, which is greenish in colour and liquid at room temperature. The saponification value of the oil is high but the iodine value is low.

Table 1. The mean composition of tamarind is given

Constituents	**Amount(Per 100 gm)**
Water	17.8-35.8 g
Protein	2-3 g
Fat	0.6 g
Carbohydrates	41.4-61.4 g
Fibre	2.9 g
Ash	2.6-3.9 g
Calcium	34-94 mg
Phosphorous	34-78 mg
Iron	0.2-0.9 mg
Thiamine	0.33 mg
Riboflavin	0.1 mg
Niacin	1.0 g
Vitamin C	44 mg

Note: source – Coronel (1991); Feungchan *et al.*, (1996 a).

3 Tamarind by-products:

Tamarind pod shell:

3.1 As fuel:

Tamarind fruit contains 30% shell by weight; a healthy tree can yield 45-150 kg of shell. Tamarind shell can be used as biomass material for manufacturing of Briquettes. Tamarind shell contains calorific value is 16.3 MJ/kg with 99% combustion efficiency.

3.2 As absorbent:

Dyes like methylene blue and amaranth are used extensively in industries like textile, paper and leather. The disposal of their wastes into the environment can be extremely undesirable. Tamarind pod shells is an effective absorbent for the removal of methylene blue and amaranth dyes from aqueous solutions (Ahalya et al. 2012). Tamarind pod shell can be used as an alternative low cost absorbent for removal of Ni (II) & Cr (VI) ions in remediation of waste water (Pandharipande et al., 2013). See Figure 3 please.

Figure 3 Tamarind pod shell

4 Tamarind seed processing:

Tamarind fruit contains 40% seed by weight; from each tree 60-200 kg of seed is available. Tamarind seed has many medicinal properties. Tamarind seed needs to be processed for removing of outer testa. There are three major operations in Tamarind seed processing; roasting, decorticating and color sorting.

4.1 Roasting :

Tamarind seed is roasted in a horizontal cyclone furnace. The furnace is having temperature of 220℃. Tamarind shells will be burned inside the furnace for attaining the required temperature. The aim of this operation is to brittle the outer layer of the tamarind seed.

4.2 Decorticating :

After roasting operation, roasted seed is sent to the decorticator for removing the outer layer of the seed. Decorticator is having spike tooth type cylinder and concave. The rotation speed of cylinder is 1500 r/min. Because of hammering action cylinder testa will be separated from the seed. After decortications husk will be removed through the concave and sieving mechanism.

4.3 Color sorting :

This operation can be by either manually or mechanically by using color sorters. The outer layer (testa) is having red color where as inside of the seed is having creamy white color. If any un-decorticated seed is left over that seed will be removed and sent for decorticating operation. See Figure 4 and Figure 5 please.

Figure 4 Tamarind seed (raw)

Figure 5 Tamarind seed (processed)

5 Uses of processed tamarind seed

5.1 Tamarind seed powder:

Processed tamarind can be grounded to make powder, in market tamarind powder is available as Tamarind seed Kernel Powder (TKP).The tamarind seed comprises mainly gum which possesses viscous characteristics and being capable of forming gel, thus it can also be applied to use as a rheology modifier in food products. In addition it can be used as an adhesive in paper industry (Prabhu et al., 2011). The tamarind seed powder is also used in vegetable and food processing industries to a great extent. Tamarind xyloglucan, commonly known as "tamarind gum" is used for thickening, stabilizing and gelling in food (Gupta et al., 1988). Tamarind gum is prepared by soaking of processed tamarind seed powder in water. By simply boiling the tamarind seed in water, the water soluble dye could be isolated and later used to dye the cotton and silk fabrics. See Figure 6 please.

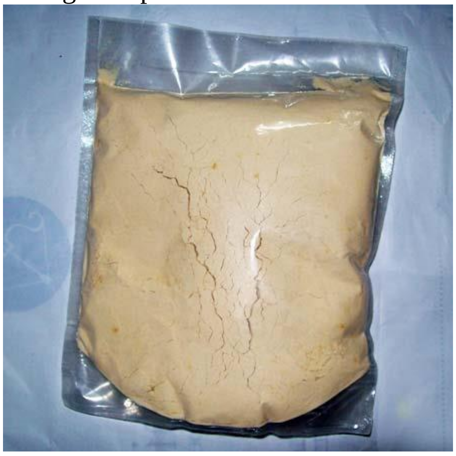

Figure 6 Tamarind seed powder

The tamarind seed dye can be used in the craft industry where the uniqueness of the products is exploited. Preparation of the tamarind seed dye into the powder form makes it more convenient compared with the solution dye (Supaluk et al., 2012).

5.2 Tamarind seed oil

Tamarind seed contains 7%-9% oil, color is in golden yellow. The amber oil extracted from tamarind seeds is also used as an illuminant and varnishing agent (El-Sidding et al., 2006).

6 Conclusions

In spite of wide range of domestic as well as industrial use, tamarind tree remains an unimproved wild tree and under exploited to meet growing commercial demand. Research activities need to enhance for processing of tamarind seeds. Nevertheless, many countries have overlooked the significance of tamarind by-products usage. To diversify the livelihood and food security all produced products are to be utilized fruitfully. Some more research works can be carried out for effective utilization of tamarind by-products. In many cases tamarind pulp is used for domestic and industrial use, it needs to be explored in different options to utilize seed, shell, testa in a better and effective way.

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